TERRAMODEL NOTE 4
Contour Maps

Objective:

The objective of this TM Note is to describe the procedure to develop a surface model and contour map from coordinate survey points. The surface model will be corrected using breaklines. Survey point editing will allow addition of 3D points to compensate for inadequate or erroneous survey points.

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TERRAMODEL Note 4--Contour Maps

To draw a contour map, the software will be used for the same processes as with manual methods. The adequacy and accuracy of the survey points will be evaluated, interpolation relationships established, and contours drawn. The following steps will be followed to generate a contour map:

1. Develop a preliminary contour map from surface model.
2. Display point elevations and labels.
3. Edit survey points and surface model.
4. Edit surface model with breaklines.
5. Define the surface model boundary.
6. Produce finished contour map.

For this TERRAMODEL note, the project **chapter4.pro** will be used. Once the project has been downloaded and TERRAMODEL has been opened:

[File]-[Open project]

Select the project chapter4.pro

[Open]

As soon as the project has been opened, immediately save the project as a different file name so that it will be usable for future turorials. Rename the project Tmnote4.pro, or chapter4.working.pro, or whatever works.

[File]-[Save project as]

Choose the appropriate folder to store the project in

In the File name window; **TMnote4**

[Save]

1. Develop a Preliminary Contour Map

Contouring Options:

The contouring options are contained in the Contour settings dialog box.

[Settings]-[Contour settings]

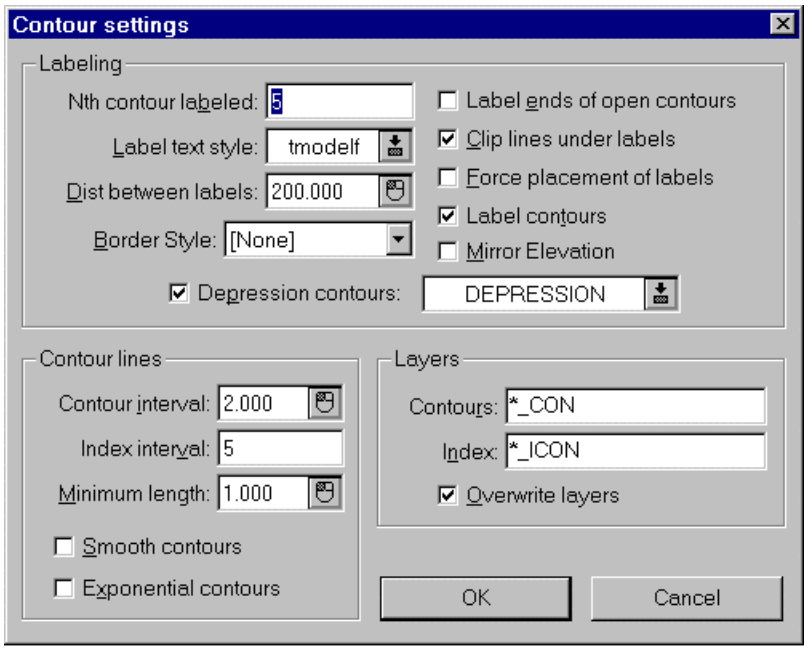

Figure 4-1

The Contour settings dialog box allows the user to edit the properties of contours. The focus can be moved to the window that is to be edited by left-clicking on that window. When the settings are satisfactory, **[OK]**. If the user decides not to save the changes that have been made, then **[Cancel]**.

Contouring procedure:

[DTM]-[Generate contours]

Select the DTM layer

Note: The Contour settings dialog box can also be accessed here by **[Settings]**

[OK] to contour

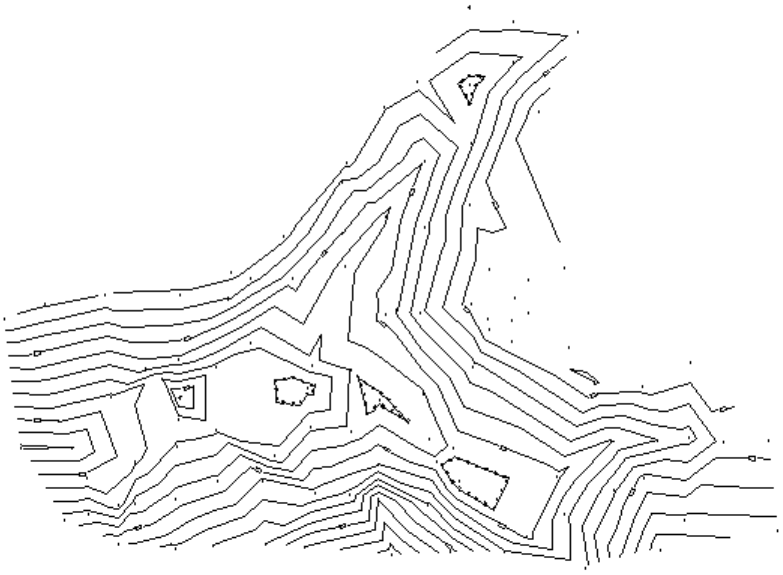

Figure 4-2

Note: Color 15 (white) was used for all of the layers so that the figures would be clear when printing.

The resulting contour map (Figure 4-2) may not accurately represent the surveyed landscape. There are editing features that allow manipulation of the surface model from which the contour map is generated.

Editing can be easier if the point labels and elevations are visible.

2. Creating Labels for Point Elevations and Names

[Draft]-[Label points with text]

This will bring up the Select points dialog box. The author believes this dialog box is unnecessary.

Without changing anything else, check the box that states “Do not display this dialog box in the future”

[OK] This will get rid of that dialog box and bring up the point labels command bar.

[Cancel] exit the command completely (because now it wants to label the points on layer 0)

Note: From now on, this dialog box will not appear when the user runs the Label points with text command. Executing the command from the menu will bring up the point labels command bar (skipping the unnecessary dialog box). If in the future the user wants the dialog box to appear when running the command, hold down **{ALT}** while executing the command from the menu.

Now the points can be labeled.

[Draft]-[Label points with text]

Change the select control to Layer, and then choose the POINTS layer.

[Settings] This brings up the Point label content dialog box.

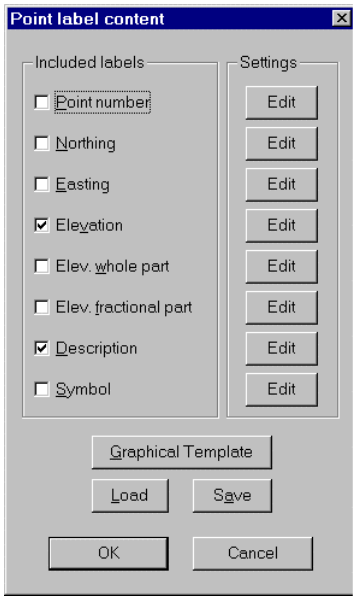

Figure 4-3

This dialog box allows the user to select which labels will be shown. If the box next to the label is checked, then that label will be shown.

For this example, the description and the elevation should be displayed, so make sure that the boxes next to the words Elevation and Description are the only boxes that are checked.

Note: The Elevation label will show the elevation of the point in the format "El=76.65". If the user chooses the Elev. whole part and Elev. fractional part labels, the elevation will be shown in the format "76.65" where the actual point is the decimal between the numbers. Remember that **{F1}** can be hit at any time to access help screens that explain the commands.

Hitting the Edit button next to each label type brings up a Point label settings dialog box.

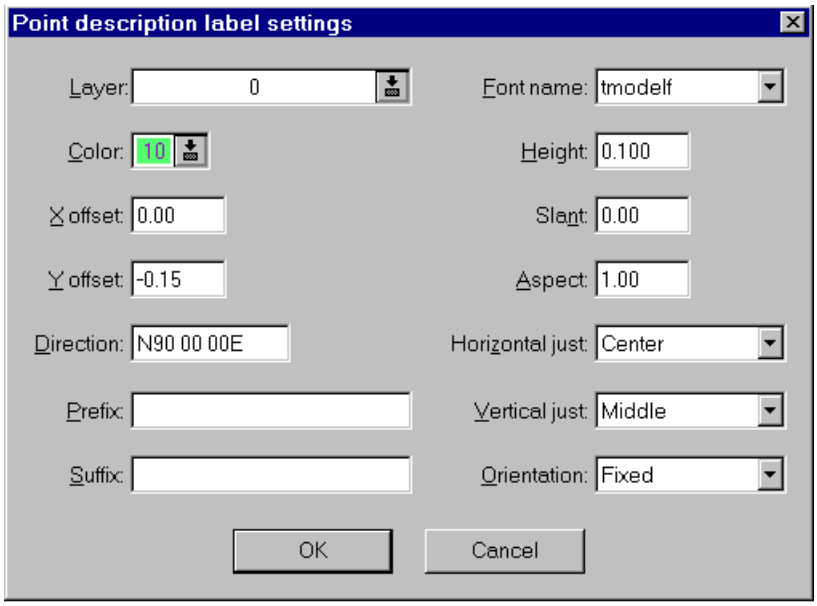

Figure 4-4

This dialog box allows the user change the layer, color, height, etc. of the label. This can be done for each type of label.

Note: When the user hits the Edit button next to Symbol, a smaller dialog box will appear that only asks for the symbol number, size, and rotation. The symbol will be "attached" to the point taking on the properties of the layer that the point is on. If the user tries to erase the symbol, the point will also be erased. In order to get rid of the symbol without deleting the point, the user must go through the process of labeling the point and leave all of the boxes in the Point label content dialog box (Figure 4-3) unchecked. The other types of labels (elevation, description, etc.) can be erased without erasing the point.

Just to the right of the word Description; **[Edit]** This brings up the dialog box shown in Figure 4-4.

Choose the POINTS layer to store the labels on.

Note: For other projects, the user may want to make a separate layer to store the labels on. That will make it easier to turn all of the labels on and off.

Choose a color, height, etc. for the label.

On the Point description label settings dialog box; **[OK]**

Just to the right of the word Elevation; **[Edit]**

Choose the POINTS layer to store the labels on.

Choose a color, height, etc. for the label.

On the Point elevation label settings dialog box; **[OK]**

On the Point label content dialog box; **[OK]**

On the command bar; **[Label]**

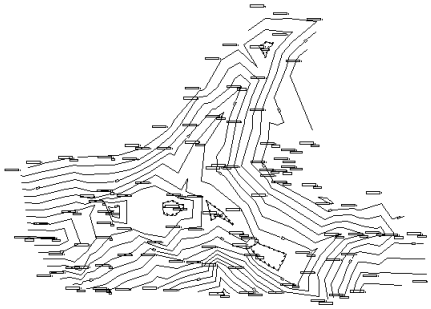

Figure 4-5

Hint: The point labels may be too small to be seen without windowing (zooming) into a smaller section of the screen. The following exercises will use the zoom process.

3. Adding & Editing Survey Points

There are instances when even the best efforts for a complete survey results in errors or a shortage of information. This creates a situation where survey points must be edited (elevations changed), deleted, moved, or inserted.

It is important that the "current" layer be the POINTS layer. The current layer is shown in the toolbar that is just above the drawing area. If the current layer is not the POINTS layer, select the POINTS layer.

In the toolbar, left-click on the down arrow just to the right of the current layer name.

Select the POINTS layer by left-clicking on it. (the selected layer will be highlighted)

On the Layer selection dialog box; **[OK]**

The tutorial file has several points that need to be edited. The points in question are in the region of the window in Figure 4-6. That region can be seen in more detail in Figure 4-7.

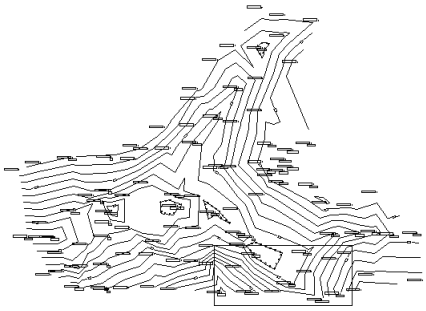

Figure 4-6

Enlarge the area with a window.

[View]-[Zoom]

[ ] select first corner

[ ] select second corner

Change Elevation:

The CL SED B point with elevation 75.45 is wrong. The elevation of the point should be 80.6.

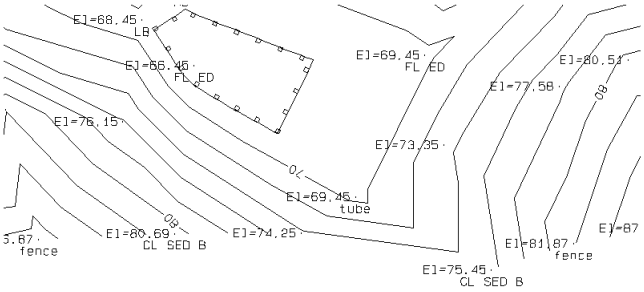

Figure 4-7

[Edit]-[Edit Object]

[ ] select the point

In the elevation window, **80.6**

On the Edit point dialog box; **[OK]**

On the command bar; **[Close]**

To freshen up the screen:

[View]-[Redraw]

Insert Point with an Elevation and Name:

A point will be created and an elevation assigned which will enable the software to close contour lines along the downstream slope of the sediment basin. The name of the point will indicate that it was not part of the original survey. The new centerline point elevation will be 80.5.

[Draw]-Point-[Point]

[ ] select the location where the point is to be inserted OR type the coordinates (**13.00, 746.5**)

In the Elevation window (Z window); **80.5**

Note: TERRAMODEL will assign the point a number. It will be visible in the "Pn:" window. The user does not have to change this default point number.

In the Name window; **CL SED B EDIT**

Note: An inserted elevation point is not part of the survey and should be labeled as such. The word "edit" should be added to the name of any point which is edited in the process of correcting the surface model.

[Point]

[Close]

Note: The point will show up as a dot. The name and elevation will not be displayed unless the labels are created for this point.

Altering point locations or elevations does not change the surface model and map until the contours are regenerated.

Re-contour to see the effects of adding this new point.

[DTM]-[Generate contours]

Select the POINTS as the DTM layer

[OK]

The next exercise will involve a different area of the map. Display the entire map.

[View]-[All]

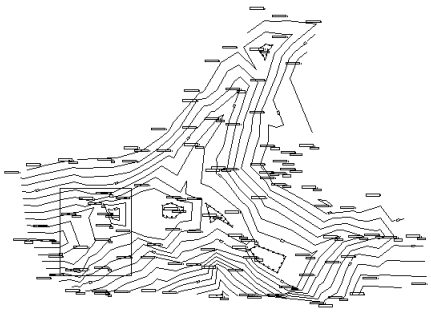

Figure 4-8

Move a survey point:

An error in processing the survey data has resulted in a centerline point (Elev 62.25) plotted in the wrong location. The point can be moved to match other centerline points. The user will need to zoom in to get a closer look at the points on centerline. (Figure 4-8)

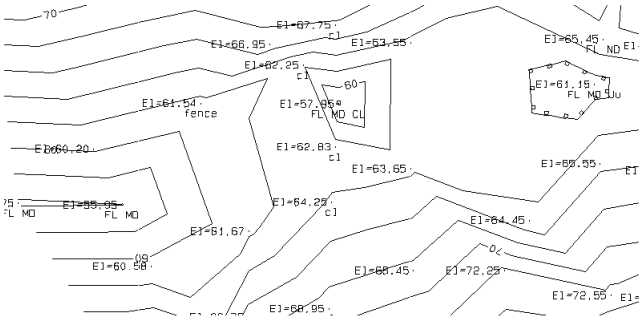

Figure 4-9

To move the centerline point with Elev. 62.25:

[Modify]-[Move]

[ ] select the point to be moved

With the focus in the From window; [ ] select the point to be moved

With the focus in the To window; [ ] select the new point location

Note: Using the above method, the point descriptions will not be moved with the point (they must be moved separately). Another method would be to select the point descriptions at the same time that the user is selecting the point to be moved (left-click on both the point and the descriptor while the focus is in the Objects window). That way the point and the descriptor can be moved at the same time.

Note: The map will not change until re-contoured.

The editing that has been done to the points will change the contour map. Re-contour the model.

[DTM]-[Generate contours]

Select the DTM layer

[OK] to contour

Delete survey point:

The "fence" point located at coordinates, North 250.39, East 159.09, will be deleted as an exercise. The erasure will then be "undone" using the Undo command.

[Edit]-[Delete]

Leaving the select control on Record; [ ] select the point to be deleted

[OK]

Note: The point descriptors will not be erased with the point and must be erased separately. Because the erase command will be “undone” in the next step, there is no need to erase the descriptors.

[Edit]-[Undo]

Move survey points to another layer:

Sometimes a survey point should not be part of the surface model and must therefore be moved to a different layer. As an example, survey points on a concrete structure would not be part of the original ground surface model.

This tutorial file has a benchmark (at coordinates 27.98, 252.5) which is not on the ground surface. Use the ReLayer command to move it to another layer.

First, re-center the screen display, using the centerline shot at elevation 68.95 as the new center:

[View]-[Recenter]

[ ] select the centerline (cl) point at 68.95

To re-layer the benchmark

[Modify]-[ReLayer]

With the select control on Record; [ ] select the benchmark point

Left-click on the down arrow just to the right of the layer name in the New layer window. This will bring up the layer selection dialog box.

A layer has not been created for the benchmark yet.

To create a new layer:

[New]

In the name window; **BM**

Select color 6 (for points and objects) and the solid line type.

On the New layer dialog box; **[OK]**

In the Layer selection dialog box, make sure that the new layer (BM) is highlighted, then **[OK]**

On the ReLayer command bar; **[OK]**

Note: The ReLayer command does not change the color of the objects moved to the new or existing layer. If the user wants the benchmark to have the color selected for the BM layer, use the Color command in the Modify menu. Also, the point descriptor will not be relayered to the new layer, so it must be relayered separately. For this exercise, it is not critical that the user change the color of the benchmark or relayer the point descriptor.

View the entire project:

[View]-[All]

Don't forget to save the file!

4. Edit Surface Model with Breaklines

Displaying Triangulated Irregular Network (TIN):

The surface model links (triangles) can be displayed to check for proper point connection and elevation interpolation by using the link settings command.

[Settings]-[Link settings] This will bring up the Link settings dialog box.

In the Elev. tolerance for flat triangles window; **1.00**

In the Maximum edge distance window; **250**

In the Maximum edge angle window; **160**

Make sure that the Display links box is checked

Make sure that the Remove flat triangles box is checked

Choose a link color of 9

In the Display links on layers window; select the POINTS layer by left-clicking on it (it will be highlighted blue when it is selected).

[OK]

Note: All of the links may not show up correctly. Using the [View]-[Redraw] and/or [View]-[All] command should fix this. If the links still aren't showing up properly, try re-contouring the map. Also, sometimes the links don't disappear when the user thinks they should. Using the Redraw command and/or the All command should correct that.

Links can be turned off by accessing the Link settings dialog box ([Settings]-[Link settings]) and then "un-checking" the Display Links box.

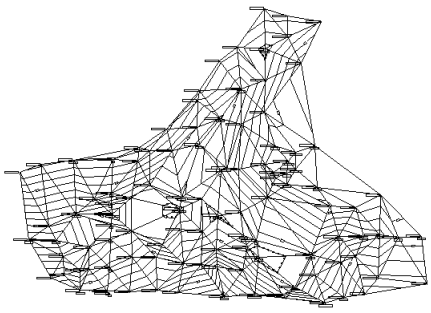

Figure 4-10

The software links the survey points to form plane surfaces from 3 adjacent points and interpolates contour elevations along the edge of the planes. Incorrect linking of points not representing a plane surface will cause contour maps to show "holes" (depressions) along the flow line of channels (Figure. 4-2) and "bulges" or "swales" along uniform slopes.

The surface model can be corrected by defining the edge of a plane with "breaklines" which connect points defining triangle legs.

Many survey points that are critical for representing the surface model are taken at consistent points on the landscape. Correcting the surface model triangles (links) is simpler if those points, which will be connected with breaklines, are identified during the survey. Flowline (FL), right and left banks (RB-LB), top and base of slopes (TOS-BOS), are examples of descriptors entered during the survey which will help edit a surface model. If these survey points are described during the survey with identical labels, they can be located easily by displaying the labels along with the associated survey points and elevations. Breaklines can then be created connecting the points.

Before selecting specific point labels to be visible, all of the point labels should be turned off.

Turn off the point labels:

[Draft]-[Label points with text]

Set the select control to Layer, and choose layer POINTS

[Settings] (this will bring up the Point label content dialog box)

Make sure that all of the boxes are unchecked

On the dialog box; **[OK]**

On the command bar; **[Label]**

Note: To turn off the labels, the user is actually re-labeling the points with nothing. The benchmark label will still be there because the benchmark point is on the BM layer and not the points layer.

Displaying Selected Point Labels:

In many instances, the labels of select points are the only ones needing displayed. For example; FL, RB, LB, CL, FENCE, etc.

For this exercise, the points identified as flowlines with a "FL" label will be turned on.

Hint: Typing "*" (asterisk) before and after the intended labels is a wildcard symbol that will capture all labels containing FL.

To label the points:

[Draft]-[Label points with text]

Set the select control to Name and left-click on the small button (looks like a box with a dot in the center) just to the right of the select control window.

In the Select by name dialog box; ***FL*** (This is case sensative)

On the dialog box; **[OK]**

On the command bar; **[Settings]**

Make sure the boxes next to the words Description, Elev. whole part, and Elev. fractional part are checked. (Notice that this is a different type of elevation label than was used before)

Next to Elev. whole part; **[Edit]**

Choose the POINTS layer to store the labels on.

Choose an appropriate color, text height, etc.

[OK]

Next to Elev. fractional part; **[Edit]**

Choose the POINTS layer to store the labels on.

Choose an appropriate color, text height, etc.

[OK]

Next to Description; **[Edit]**

Choose the POINTS layer to store the labels on.

Choose an appropriate color, text height, etc.

[OK]

On the Point label content dialog box; **[OK]**

On the command bar; **[Label]**

Turn off the links:

[Settings]-[Link settings]

On the Link settings dialog box; uncheck the Display links box

[OK]

As was stated before, when the links don't disappear try using the Redraw or All commands under the View menu.

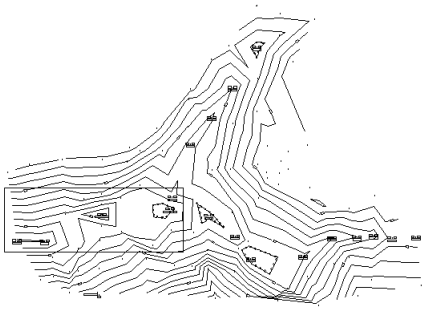

Figure 4-11

Points labeled with the FL descriptor are visible in Figure 4-11.
Use the Zoom command to enlarge the area shown in Figure 4-11.

Adding Breaklines To Correct Surface Model:

Note: This section describes the process of manual breakline insertion. Refer to TERRAMODEL Note 3 for instructions on the automatic insertion of breaklines using point descriptors.

Breaklines are constructed between two points by placing the cursor box over the points and selecting them with the mouse button. **{ESC}** stops the process.

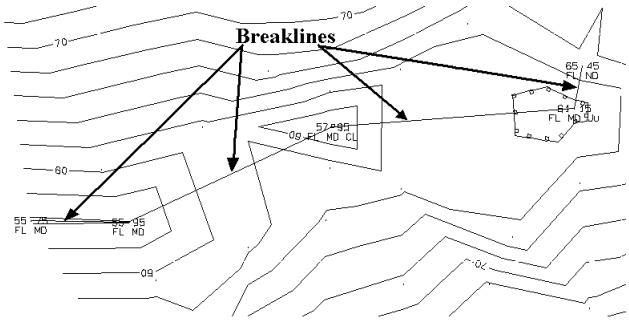

Figure 4-12

To add breaklines:

[Draw]-Set-[Breakline]

[ ] select the first point to be connected

[ ] select additional points

{ESC} or **[Close]** to exit the command.

The breakline will take on the layer and color of the first point that is selected in the series. Also, **[New]** will allow the user to begin a new breakline without having to completely exit and re-start the command.

Hint: Recontour to see the effects adding breaklines had on this section of the model.

The remaining breaklines can be drawn by using the View All command to show the entire map, and then connecting the flowline points in sequence.

Deleting Breaklines:

A breakline connecting two points incorrectly can be erased.

[Edit]-[Break]

[ ] select the breakline to erase

Breakline effectiveness and accuracy can be checked by periodically recontouring.

[DTM]-[Generate contours]

Select POINTS as the DTM layer

[OK]

The edited contour map (without the flowline labels) is shown in Figure 4-13.

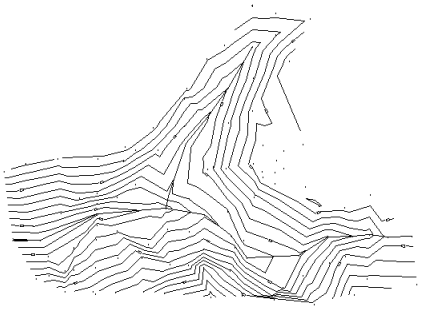

Figure 4-13

Turn on all the point labels:

[Draft]-[Label points with text]

Set the select control to Layer and choose the POINTS layer

[Settings]

As before, check the boxes of the labels to be displayed (elevations and descriptions for this example), then **[Edit]** to set the layer, color, text height, etc. of the labels.

On the Point label content dialog box; **[OK]**

On the command bar; **[Label]**

5. Define the Surface Model Boundary

Often times, the contour lines will extend past the limits of the survey. For example the software may interpolate two survey points on the edge of the survey that are on opposite sides of a nose of a hill.

The software defines the boundary of the surface model as the edge of the triangulated network, which is determined by the maximum triangle leg specified by the user (maximum edge distance).

Previously, the user displayed the links using [Settings]-[Link settings]. In doing so, the user had the opportunity to set the maximum edge distance, or link length. The default length is currently set to 250 feet, which tells the software to interpolate between any two points that are 250 feet or less apart.

Another method exists to limit the boundary of the surface model and contour map. Draw a contiguous set around the outside of the surface model to define the edge or boundary. The software will not contour, interpolate, or perform any calculations outside this boundary.

WARNING! There are a few requirements for this set: (1) There can't be any 3D points outside of the set on the DTM layer, (2) All of the points along the set must be 3D points, and (3) All of the points along the set must be on the same layer.

A quick way to draw this boundary is to draw the default boundary (based on maximum edge distance) using the DTM edge command; then correct or modify it as necessary.

Draw the DTM edge for the POINTS layer. First edit the color of layer POINTS so it will be easy to distinguish the DTM edge.

Make POINTS the current layer (if it is not already)

In the toolbar, left-click on the down arrow just to the right of the current layer name

In the Layer selection dialog box; [ ] select the POINTS layer

[OK]

Change the object color to 13

In the toolbar, left-click on the down arrow just to the right of the object color

Note: The first color window is the object color and the second color window is the point color.

In the Color selection dialog box, choose color 13 by left-clicking on it

[OK]

Create the DTM edge:

[DTM]-[DTM edge]

Select POINTS as the DTM layer

[OK]

The default boundary for the surface model will drawn using color 13 (the object color of the DTM layer). The following steps will allow the user to practice editing this default edge.

Zoom in to the area shown in Figure 4-14.

[View]-[Zoom]

[ ] select first corner

[ ] select second corner

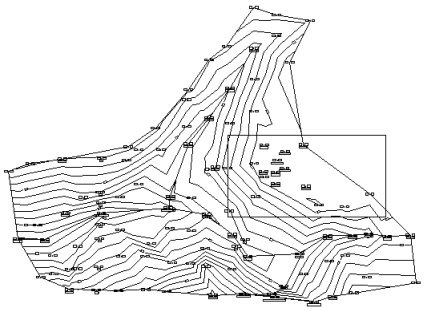

Figure 4-14

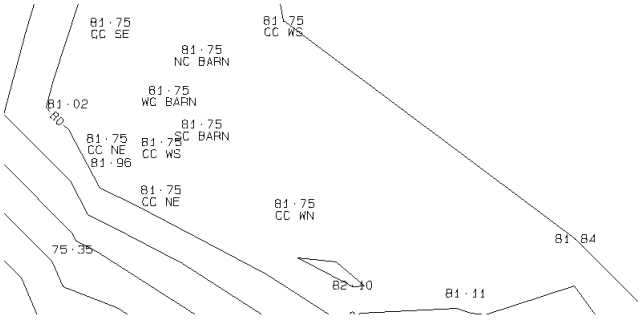

Figure 4-15

Break out the set line connecting CC WS (elevation 81.75) and the point at elevation 81.84.

[Edit]-[Break]

[ ] select the segment to be broken

Finish the set to define the desired boundary (Figure 4-16):

[Draw]-Set-[Set]

[ ] select the point at CC WS

[ ] select the point at CC WN

[ ] select the point at elevation 82.10

[ ] select the point at elevation 81.84

{ESC} or **[Close]** to exit the command

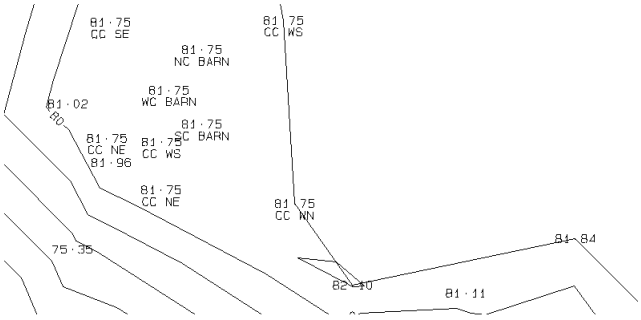

Figure 4-16

Re-contour to see the results. Notice the 82' contour is no longer a closed contour, Figure 4-17.

[DTM]-[Generate contours]

Select POINTS as the DTM layer

[OK]

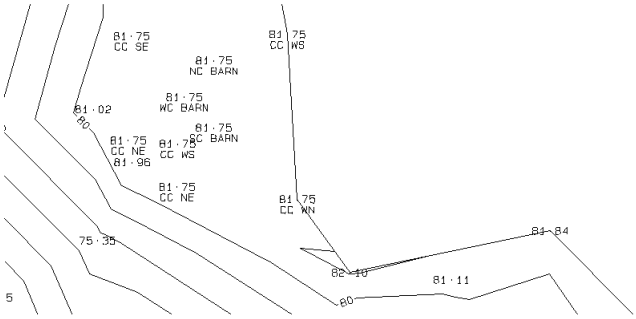

Figure 4-17

Display the entire map.

[View]-[All]

6. Produce a Finished Contour Map

The finished contour map should have the points and point labels turned off.

Turn off the points:

Note: It is recommended that the user make the points invisible instead of turning them off

In the toolbar; **[L Set]** (This brings up the Layer settings dialog box)

Highlight both the POINTS and BM layers. Do this by left-clicking on one of the layer names, then while holding down **{CTRL}** left-click on the other layer name. Both layer names should be highlighted.

Un-check the box next to the word Visible by left-clicking on it. It may take more than one click to remove the check.

[OK]

If the user put the labels on the POINTS or BM layers, they should have disappeared with the points. If the user put the labels on a different layer, that layer will have to be made invisible also.

Hint: The user may prefer the finished contour map to have smooth contour lines (Figure 4-18). Do this by enabling the Smooth contours check box found in the Contour settings dialog box. Access the Contour settings dialog box using [Settings]-[Contour settings]. Re-contour the drawing to see the smooth contours.

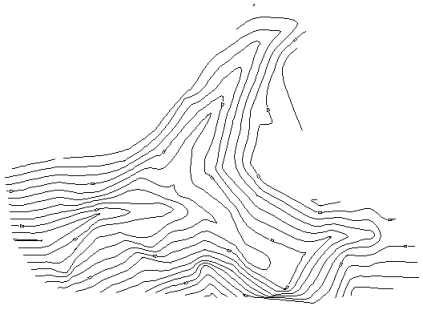

Figure 4-18

Don't forget to save the file regularly!!